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UTILITY PATENT APPLICATION TRANSMITTAL <small>(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))</small>	Attorney Docket No	JARED--005A
	First Inventor or Application Identifier	Unknown
	Title	METHOD OF PRODUCING ORTHOTIC ...
	Express Mail Label No.	EL661569517US

APPLICATION ELEMENTS <small>See MPEP chapter 600 concerning utility patent application contents.</small>	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231	
1. <input checked="" type="checkbox"/> * Fee Transmittal Form (e.g., PTO/SB/17) <small>(Submit an original and a duplicate for fee processing)</small>	5. <input type="checkbox"/> Microfiche Computer Program (Appendix)	
2. <input checked="" type="checkbox"/> Specification [Total Pages 21] <small>(preferred arrangement set forth below)</small> <ul style="list-style-type: none">- Descriptive title of the Invention- Cross References to Related Applications- Statement Regarding Fed sponsored R & D- Reference to Microfiche Appendix- Background of the Invention- Brief Summary of the Invention- Brief Description of the Drawings (if filed)- Detailed Description- Claim(s)- Abstract of the Disclosure	6. Nucleotide and/or Amino Acid Sequence Submission <small>(if applicable, all necessary)</small> <ul style="list-style-type: none">a. <input type="checkbox"/> Computer Readable Copyb. <input type="checkbox"/> Paper Copy (identical to computer copy)c. <input type="checkbox"/> Statement verifying identity of above copies	
3. <input checked="" type="checkbox"/> Drawing(s) (35 U.S.C. 113) [Total Sheets 4]	ACCOMPANYING APPLICATION PARTS 7. <input type="checkbox"/> Assignment Papers (cover sheet & document(s)) 8. <input type="checkbox"/> 37 C.F.R. § 3.73(b) Statement of Power of Attorney <small>(when there is an assignee)</small> 9. <input type="checkbox"/> English Translation Document (if applicable) 10. <input type="checkbox"/> Information Disclosure Statement (IDS)/PTO-1449 [Copies of IDS Citations] 11. <input type="checkbox"/> Preliminary Amendment 12. <input checked="" type="checkbox"/> Return Receipt Postcard (MPEP 503) <small>(Should be specifically itemized)</small> 13. <input checked="" type="checkbox"/> * Small Entity Statement(s) filed in prior application, Status still proper and desired <small>(PTO/SB/09-12)</small> 14. <input type="checkbox"/> Certified Copy of Priority Document(s) <small>(if foreign priority is claimed)</small> 15. <input type="checkbox"/> Other: _____	
4. Oath or Declaration [Total Pages 2] <ul style="list-style-type: none">a. <input checked="" type="checkbox"/> Newly executed (original or copy)b. <input type="checkbox"/> Copy from a prior application (37 C.F.R. § 1.63(d)) <small>(for continuation/divisional with Box 16 completed)</small><ul style="list-style-type: none">i. <input type="checkbox"/> DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).		
* NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).		
16. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below and in a preliminary amendment. <input type="checkbox"/> Continuation <input type="checkbox"/> Divisional <input type="checkbox"/> Continuation-in-part (CIP) of prior application No: _____ Prior application information: Examiner _____ Group / Art Unit: _____		

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS					
<input type="checkbox"/> Customer Number or Bar Code Label (Insert Customer No. or Attach bar code label here) or <input checked="" type="checkbox"/> Correspondence address below					
Name	STETINA BRUNDA GARRED & BRUCKER Attention: Eric L. Tanezaki				
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Signature	Eric L. Tanezaki	Date	10/24/00

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FEE TRANSMITTAL for FY 2001

Patent fees are subject to annual revision

Complete if Known

Application Number	Unknown
Filing Date	Herewith
First Named Inventor	Stephen J. Jared
Examiner Name	Unknown
Group Art Unit	Unknown
Attorney Docket No.	JARED-005A

TOTAL AMOUNT OF PAYMENT (\$ 467.00)

METHOD OF PAYMENT

1. ☒ The Commissioner is hereby authorized to charge indicated fees and credit any overpayments to:

Deposit Account Number 19-4330

Deposit Account Name STETINA BRUNDA ...

- ☒ Charge Any Additional Fee Required Under 37 CFR 1.16 and 1.17

- ☒ Applicant claims small entity status See 37 CFR 1.27

2. ☒ Payment Enclosed:

☒ Check ☐ Credit card ☐ Money Order ☐ Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
101 710	201 355	Utility filing fee	355
106 320	206 160	Design filing fee	
107 490	207 245	Plant filing fee	
108 710	208 355	Reissue filing fee	
114 150	214 75	Provisional filing fee	

SUBTOTAL (1) (\$ 355.00)

2. EXTRA CLAIM FEES

Total Claims 28 -20** = 8 x 9 = 72

Independent Claims 4 -3** = 1 x 40 = 40

Multiple Dependent ☐ = 112

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description
103 18	203 9	Claims in excess of 20
102 80	202 40	Independent claims in excess of 3
104 270	204 135	Multiple dependent claim, if not paid
109 80	209 40	** Reissue independent claims over original patent
110 18	210 9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) (\$ 112)

**or number previously paid, if greater; For Reissues, see above

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code (\$)	Small Entity Fee Code (\$)	Fee Description	Fee Paid
105 130	205 65	Surcharge - late filing fee or oath	
127 50	227 25	Surcharge - late provisional filing fee or cover sheet	
139 130	139 130	Non-English specification	
147 2,520	147 2,520	For filing a request for ex parte reexamination	
112 920*	112 920*	Requesting publication of SIR prior to Examiner action	
113 1,840*	113 1,840*	Requesting publication of SIR after Examiner action	
115 110	215 55	Extension for reply within first month	
116 390	216 195	Extension for reply within second month	
117 890	217 445	Extension for reply within third month	
118 1,390	218 695	Extension for reply within fourth month	
128 1,890	228 945	Extension for reply within fifth month	
119 310	219 155	Notice of Appeal	
120 310	220 155	Filing a brief in support of an appeal	
121 270	221 135	Request for oral hearing	
138 1,510	138 1,510	Petition to institute a public use proceeding	
140 110	240 55	Petition to revive - unavoidable	
141 1,240	241 620	Petition to revive - unintentional	
142 1,240	242 620	Utility issue fee (or reissue)	
143 440	243 220	Design issue fee	
144 600	244 300	Plant issue fee	
122 130	122 130	Petitions to the Commissioner	
123 50	123 50	Petitions related to provisional applications	
126 240	126 240	Submission of Information Disclosure Stmt	
581 40	581 40	Recording each patent assignment per property (times number of properties)	
146 710	246 355	Filing a submission after final rejection (37 CFR § 1.129(a))	
149 710	249 355	For each additional invention to be examined (37 CFR § 1.129(b))	
179 710	279 355	Request for Continued Examination (RCE)	
169 900	169 900	Request for expedited examination of a design application	

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) (\$)

SUBMITTED BY

Name (Print/Type) Eric L. Tanegaki

Signature Eric L. Tanegaki

Registration No. 40,196

(Attorney/Agent)

Complete (if applicable)

Telephone 949-855-1246

Date 10/24/00

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**STATEMENT CLAIMING SMALL ENTITY STATUS
 (37 CFR 1.9(f) & 1.27(b))—INDEPENDENT INVENTOR**

Docket Number (Optional)
JARED-005A

Applicant, Patentee, or Identifier: Stephen J. Jared

Application or Patent No.: Unknown

Filed or issued: Herewith

Title: METHOD OF PRODUCING ORTHOTIC DEVICE UTILIZING MILL PATH
 ABOUT PERPENDICULAR AXIS

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.
☐ the application identified above.
☐ the patent identified above.

I have not assigned, granted, conveyed, or licensed, and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ No such person, concern, or organization exists.
☐ Each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

Stephen J. Jared

NAME OF INVENTOR

NAME OF INVENTOR

NAME OF INVENTOR

Stephen J. Jared
 Signature of inventor

Signature of inventor

Signature of inventor

October 24, 2000
 Date

Date

Date

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004200-00646960

JARED-005A

CERTIFICATE OF MAILING

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√ I hereby certify that this correspondence is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10, Express Mail No. EL661569517US on the date indicated below and is addressed to Assistant Commissioner of Patents, BOX Patent Application, Washington, DC 20231 on the date indicated below

on October 24, 2000
(Date)


Signature

Carrie E. Allen

Typed or printed name of person signing Certificate

Note: Each paper must have its own certificate of mailing, or this certificate must identify each submitted paper.

1. Utility Patent Application Transmittal;
2. Fee Transmittal (in duplicate);
3. Declaration;
4. Statement claiming Small Entity Status;
5. Specification (21 pages);
6. Drawings (4 pages);
7. Certificate of Mailing; and
8. Return Postcard

JC931 U.S. PAT.
09/694900
10/24/00

Case No.: JARED-005A
Pat. Appln.

TITLE OF THE INVENTION

5 **METHOD OF PRODUCING ORTHOTIC DEVICE
UTILIZING MILL PATH ABOUT PERPENDICULAR AXIS**

CROSS-REFERENCE TO RELATED APPLICATIONS

(Not Applicable)

10

STATEMENT RE: FEDERALLY SPONSORED RESEARCH/DEVELOPMENT

(Not Applicable)

BACKGROUND OF THE INVENTION

15 The present invention relates generally to fabrication
of orthotic devices, and more particularly to a method of
producing orthotic devices utilizing an optimized milling
path.

20 The prior art provides for the computer controlled
manufacturing of orthotic devices or appliances from a
workpiece of solid material, such as plastic. Typically,
such a process begins with the generation of computer model
of a patient's foot, for example. This may be accomplished
by using an optical scanner or electro-mechanical contact
25 apparatus. The computer model may be adapted with a
prescriptive modification to generate computer model of a
desired orthotic device. A milling tool may be used to
selectively remove material from the plastic workpiece so
as to expose a surface contour corresponding to the desired
30 orthotic device computer model. Thus, the remaining
material of the workpiece forms the basis of the desired
orthotic device. This may be accomplished via a computer

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numerical controlled (CNC) process. Subsequent to such CNC process further machining may be required for final completion of the device. For example, a surface machining process may be desired, such as grinding, polishing or sandblasting.

For example, a prior art milling path is disclosed in U.S. Patent No. 5,054,148 which as understood calls for the milling tool to translate in a back and forth motion across the desired orthotic device to form a series of parallel grooves. However, such a prior art milling path requires abrupt direction changes, 180 degree turns. Such abrupt direction changes require that the associated milling tool decelerate upon making such abrupt direction changes and may even result in a momentary stoppage of motion. Subsequently, the milling tool is required to quickly accelerate to continue milling. Such deceleration and acceleration cycling is inefficient in terms of overall fabrication time of the orthotic device.

It is therefore evident that there exists a need in the art for a method of more efficiently producing orthotic devices in comparison to the prior art.

BRIEF SUMMARY OF THE INVENTION

In accordance with an aspect of the present invention, there is provided a method of milling an orthotic device by using a computer controlled milling tool. The orthotic device is defined by an orthotic device upper contour. The method begins with providing a workpiece which defines a mill plane and a perpendicular axis thereto. The method further provides for milling the milling tool into the workpiece along the perpendicular axis to a depth corresponding to the orthotic device upper contour. The

method further provides for translating the milling tool relative to the workpiece in the mill plane along a milling path while adjusting the depth of the milling tool to correspond to the orthotic device upper contour to selectively remove material from the workpiece for producing the orthotic device therefrom. The milling path is characterized by a plurality of mill rotations about the perpendicular axis. Successive ones of the mill rotations are radially further from the perpendicular axis.

Preferably, the milling tool is translated in the mill plane at a substantially constant speed. Further, the milling tool is sized and configured to perform a climb cut into the workpiece. The milling tool has a spherical-shaped end mill and the milling tool is translated along the milling path which aligns the spherical-shaped end mill tangentially with the orthotic device upper contour.

In another embodiment of an aspect of the present invention, there is a method of generating data for controlling a computer controlled milling tool to mill a workpiece to form an orthotic device therefrom having an orthotic device upper contour. The method provides for accessing contour data representative of the orthotic device upper contour. The contour data is relatable to a mill plane and a perpendicular axis thereto. The method further provides for generating milling path data using the accessed contour data. The milling path data is representative of a milling path characterized by a plurality of mill rotations about the perpendicular axis. Successive ones of the mill rotations are radially further from the perpendicular axis. Preferably, the milling path data is calculated to translate the milling tool in the mill plane at a substantially constant speed. Further, the milling path data is calculated to configure the milling

tool to perform a climb cut into the workpiece. The
milling tool may have a spherical-shaped end mill and the
milling path is calculated to align the spherical-shaped
end mill tangentially with the orthotic device upper
5 contour.

In another embodiment of an aspect of the present
invention, there is provided a method of milling an
orthotic device by using a computer controlled milling
tool. The milling tool has a spherical-shaped end mill.
10 The orthotic device is defined by an orthotic device upper
contour. The method begins with providing a workpiece
defining a mill plane and a perpendicular axis thereto.
The method further provides for milling the milling tool
into the workpiece along the perpendicular axis to a depth
15 corresponding to the orthotic device upper contour. The
method further provides for translating the milling tool
relative to the workpiece in the mill plane along a milling
path while adjusting the depth of the milling tool to
correspond to the orthotic device upper contour to
20 selectively remove material from the workpiece for
producing the orthotic device therefrom. The milling path
is configured to align the spherical-shaped end mill
tangentially with the orthotic device upper contour.
Preferably, the milling path being characterized by a
25 plurality of mill rotations about the perpendicular axis.
Successive ones of the mill rotations are radially further
from the perpendicular axis. The milling tool is
translated in the mill plane at a substantially constant
speed.

30 In yet another embodiment of an aspect of the present
invention, there is a method of generating data for
controlling a computer controlled milling tool to mill a
workpiece to form an orthotic device therefrom having an

orthotic device upper contour. The milling tool has a spherical-shaped end mill. The method provides for accessing contour data representative of the orthotic device upper contour. The contour data is relatable to a mill plane and a perpendicular axis thereto. The method further provides for generating milling path data using the accessed contour data. The milling path data is representative of a milling path. The milling path is configured to align the spherical-shaped end mill tangentially with the orthotic device upper contour. Preferably, the milling path is characterized by a plurality of mill rotations about the perpendicular axis. Successive ones of the mill rotations are radially further from the perpendicular axis. The milling tool is translated in the mill plane at a substantially constant speed.

As such, the present invention mitigates the inefficiencies and limitations associated with prior art methods of producing orthotic devices. Advantageously, the present invention utilizes a milling path which seeks to optimize the time, power and motion efficiency of the milling tool. In this regard, in the preferred embodiment of the present invention, the milling path is characterized by a plurality of mill rotations about the perpendicular axis with successive ones of the mill rotations being radially further from the perpendicular axis. Such a milling path is contemplated to avoid or mitigate the need to perform abrupt direction changes or highly radiused turns. Such abrupt direction changes or highly radiused turns typically require that the associated milling tool decelerate upon making such abrupt direction changes and may even result in a momentary stoppage of motion, as in the case of a complete 180 degree direction change.

Subsequently, the milling tool is required to quickly accelerate to continue milling. The present invention mitigates against such deceleration and acceleration cycling, thereby allowing milling to take place at a substantially constant rate in comparison to the prior art. This advantageously translates into a reduced overall fabrication time of the orthotic device.

Further, such a milling path facilitates the milling tool to perform a climb cut into the workpiece. Significantly, a climb cut tends to draw the material desired to be milled towards the milling tool. This tends to result in less power consumption requirements of the milling tool. In contrast, prior art milling paths tend to employ both climb cuts and the less efficient conventional cuts.

Another advantage of an aspect of the present invention is in the case where the milling tool has a spherical-shaped end mill and the milling tool is translated along the milling path which aligns the spherical-shaped end mill tangentially with the orthotic device upper contour. In this regard, the milling path of the present invention compensates for a tool center off-set between an optimized milling contact point upon the spherical-shaped end mill and the material being milled. In particular, the tangent of the spherical-shaped end mill to the material being milled of the workpiece is used to calculate the milling path. This is especially significant adjacent highly contoured portions of the orthotic device such at a posterior portion thereof, such as corresponding to a heel portion of the orthotic device.

Accordingly, the present invention represents a significant advance in the art.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING

These, as well as other features of the present invention, will become more apparent upon reference to the drawings wherein:

5 Figure 1 is a symbolic perspective view of a milling tool as shown with a workpiece;

 Figure 2 is the milling tool and workpiece of Figure 1 as shown with the milling tool disposed along a perpendicular axis into the workpiece to a depth of
10 an orthotic device upper contour;

 Figure 3 is the milling tool and workpiece of 3 Figure as shown with the milling tool translated along a milling path;

 Figure 4 is the milling tool and workpiece of
15 Figure 3 as shown with the milling tool translated along the milling path about the perpendicular axis;

 Figure 5 is the workpiece of Figure 4 as shown with an exposed orthotic device upper contour;

 Figure 6 is a top view of a milling path of the
20 method of the present invention;

 Figure 7 is a perspective view of the milling path of Figure 6;

 Figure 8 is a symbolic sectional side view of an
25 end mill of a milling tool in relation to the orthotic device upper contour;

 Figure 9 is a flow diagram of a method of an embodiment of an aspect of the present invention; and

 Figure 10 is a flow diagram of a method of
30 another embodiment of an aspect of the present invention.

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DETAILED DESCRIPTION OF THE INVENTION

Referring now to the drawings wherein the showings are for purposes of illustrating a preferred embodiment of the present invention only, and not for purposes of limiting
5 the same, Figures 1-10 illustrate the method of producing orthotic devices of the present invention.

Referring now to Figure 1, the present invention contemplates use of a milling tool 10 as symbolically depicted. The milling tool 10 is computer controlled, and
10 may be a computer numeric controlled (CNC) device. The milling tool 10 is equipped with an end mill 12. Preferably, the end mill 12 is spherical-shaped. The milling tool 10 is configured to move the end mill 12 relative to a workpiece 14. The milling tool 10 and
15 supporting equipment for moving the workpiece 12 relative thereto, such servo motors, may be chosen from those which is well known to one of ordinary skill in the art.

The present invention contemplates the milling of a workpiece 14 to form an orthotic device 16 therefrom (as
20 symbolically shown in phantom). Suitable materials used to form the workpiece 14 may be chosen from those well known to one of ordinary skill in the art. As used herein it is contemplated that the term orthotic device 16 may include any device which is configured to be affixed adjacent a
25 distal end of an anatomical structure, such as the bottom of a patient's foot. Additionally, it is contemplated that the term orthotic device 16 further includes positive moldings of such anatomical structure distal end, corrected or uncorrected. In a preferred embodiment of an aspect of
30 the present invention, the orthotic device 16 has orthotic device upper and lower contours 18, 20.

The method begins with providing the workpiece 14. As the typical orthotic device 16 is contemplated to be contained within a rectangular solid volume, the workpiece 14 will typically be similarly shaped. It is contemplated that multiple workpieces 14 each associated with an orthotic device 16 may be formed from a single block of material. In this regard, the term workpiece 14 as used herein may refer to a portion of a material dedicated to the formation of an orthotic device 16.

The workpiece 14 defines a mill plane 30 (Z-axis) and a perpendicular axis 32 (the plane defined by the X-axis and the Y-axis) thereto. In this regard, the workpiece 14 may have a workpiece top surface 34. It is contemplated that movement of the milling tool 10 relative to the workpiece 14 may be accomplished any number of ways. For example, a conventional milling technique involves the milling tool 10 having a degree of freedom along a vertical or Z-axis which is perpendicular to the workpiece top surface 34, and the workpiece 14 having degrees of freedom in a plane perpendicular to such vertical axis. In this regard, the milling tool 10 may be configured to move along the perpendicular axis 32 and the workpiece 14 may be configured to translate in the mill plane 30. As such, as contemplated herein, movement of the milling tool 10 with respect to the workpiece 14 is in regards to relative movement.

Referring now to Figure 2, the method further provides for milling the milling tool 10 into the workpiece 14 along the perpendicular axis 32 to a depth corresponding to the orthotic device upper contour 18.

The method further provides for translating the milling tool 10 relative to the workpiece 14 in the mill plane 30 along a milling path 36 while adjusting the depth

of the milling tool 10 to correspond to the orthotic device upper contour 18 to selectively remove material from the workpiece 14 for producing the orthotic device 16 therefrom. In sequence with Figure 2, Figure 3 depicts the milling tool 10 having translated along the Y-axis along the milling path 36 generally away from the Z-axis. In sequence with Figure 3, Figure 4 depicts the milling tool 10 having continued along the milling path 36 generally towards the Z-axis.

As used herein, the milling path 36 may include a path which refers to a locus of points which is associated with fixed portion of the milling tool 10, such as a center of an end mill or the distal-most point thereof, during a milling operation. However, in another embodiment of an aspect of the present invention, as further discussed below, the milling path 36 may be generated to account for such locus of points which is associated with a point of contact between the milling tool 10 and the intended orthotic device upper contour 18 (or intended orthotic device lower contour 20, as applicable) during a milling operation.

Referring now to Figure 6, there is depicted a top view of the milling path 36 as superimposed upon the orthotic device 16 along the orthotic device upper contour 18. Figure 7 is a perspective view of milling path 36 only.

Referring to Figure 6, the milling tool 10 of Figure 3 corresponds to milling path location 38. As such, in this embodiment, the milling tool 10 translates from the perpendicular axis 32 to milling path location 38. Next, the milling path 36 continues along a lane change segment 40a to milling path location 42. From milling path location 42 the milling path 36 continues generally towards

the perpendicular axis 32 through milling path location 44 which corresponds to position of the milling tool 10 of Figure 4.

Importantly, in the present embodiment of the present invention, the milling path 36 is characterized by a plurality of mill rotations 38n about the perpendicular axis 32. Successive ones of the mill rotations 38n, such as mill rotations 38a, 38b and 38c, are radially further from the perpendicular axis 32. As used herein the terms radially further refers to the overall dimensions of the mill rotations 38n in comparison with each other. In this regard, milling path location 44 is located upon mill rotation 38a. The next successive one of the mill rotations 38n is mill rotation 38b. Lane change segment 40b is utilized to traverse from mill rotation 38b to mill rotation 38c. Similarly, lane change segment 40c is utilized to traverse outwardly from mill rotation 38c to the next succeeding mill rotations 38n. Other lane change segments 40n are utilized in similar fashion.

While the mill rotations 38n are depicted to be connected via the use of the lane change segments 40n, such lane change segments 40n are not so required. In this regard, it is contemplated that the mill rotations 38n may be successively joined by a gradual spiraling of the milling rotations 38n such that an end of a given one blends with the beginning of the next.

The mill rotations 38 are generally elliptical-shaped. In this regard, as used herein, the term "generally elliptical-shaped" not only refers to circles and ellipses, but more loosely refers to generally rounded polygonal shapes as well.

In a typical arrangement, the orthotic device 16 has opposing anterior and posterior portions 22, 24. The

anterior portion 22 has a primary width 26 and the posterior portion 24 has a secondary width 28. Typically, the orthotic device 16 has a primary width 26 greater than the secondary width 28, as shown. In the case of the
5 orthotic device 16 being used in connection with a patient's foot, the posterior portion 24 would correspond to the heel of the foot. In this regard, the portion of the orthotic device upper contour 18 which is disposed adjacent the posterior portion 24 would be anticipated to
10 be substantially contoured. The present embodiment of the method of the present invention will now be more fully discussed in the context of such typical, but not required, orthotic device configuration.

In an embodiment of the present invention, given ones
15 of a portion of the mill rotations 38n are characterized by having an elliptical section 46 (a representative few are denoted) adjacent the posterior portion 24.

In an embodiment of the present invention, given ones
20 of the portion of the mill rotations 38n are characterized by having a first arced section 48 (a representative few are denoted) and a second arced section 50 (a representative few are denoted) disposed adjacent the anterior portion 22.

In the preferred embodiment of the present invention,
25 the milling tool 10 is translated in the mill plane 30 at a substantially constant speed. In this regard, the minimal radius of arcs and turns along the milling path 36 are preferably calculated to maintain such constant speed of translation. It is contemplated that such minimal
30 radius is a function of the various tolerances of the movement control mechanisms, e.g., bearings and ball screws.

Advantageously, in the preferred embodiment of the present invention, the milling tool 10 is sized and configured to perform a climb cut into the workpiece 14. In this regard, in the embodiment shown, the milling tool 10 is rotated clockwise with the milling path 36 following milling rotations 38n counter-clockwise.

Referring now to Figure 8 there is depicted a symbolic sectional side view of the end mill 12 of the milling tool 10 in relation to the orthotic device upper contour 18. In another embodiment of an aspect of the present invention, the milling tool 10 has a spherical-shaped end mill 12. In this regard, the end mill 12 may be characterized by a radius r . The milling tool 10 may be translated along the milling path 36 which aligns the spherical-shaped end mill 12 tangentially with the orthotic device upper contour 18. In this respect, the end mill 12 contacts the upper device contour 18 at tangent point 52. It is contemplated such tangential milling in reference to the intended contour compensates for an off-set between a fixed reference point of the end mill 12, such as along its axis. Thus, the mill path 36 is a function of the upper contour 18 (in three dimensions), rather than the perimeter boundaries of the orthotic device in the mill plane 30. In this regard, because the milling path 36 takes into account such off-set, such milling path 36 is contemplated to result in an actually milled contour which is more closely manufactured to its intended design.

It is contemplated that the above described milling operation and techniques as discussed and shown in reference to the orthotic device upper contour 18 may be similarly applied to the orthotic device lower contour 20.

Referring now to Figure 9, there is depicted a flow diagram of a method of an embodiment of an aspect of the

present invention as discussed above. In this regard, the method generally calls for the steps of providing 54 the work piece 14, milling 56 along the perpendicular axis 32, and translating 58 along the milling path 36.

5 Referring now to Figure 10, the present invention further contemplates a method of generating data for controlling the computer controlled milling tool 10 to mill the workpiece 14 to form the orthotic device 16 therefrom having the orthotic device upper contour 18. In this
10 respect, such method is contemplated to be performed within a computer executable software program which may be self contained, such a discrete software module, or distributed between multiple software components.

The method initially contemplates accessing 60 contour
15 data representative of the orthotic device upper contour 18. The contour data is relatable to the mill plane 30 and the perpendicular axis 32 thereto. In this regard, such data is contemplated to be stored in a computer readable format. Next, milling path data is generated 62 using the
20 accessed contour data. The milling path data is representative of a milling path (depicted as milling path 36) characterized by a plurality of mill rotations (depicted as mill rotations 38n) about the perpendicular axis 36. Successive ones of the mill rotations 38n being
25 radially further from the perpendicular axis 36.

Additional modifications and improvements of the present invention may also be apparent to those of ordinary skill in the art. Thus, the particular combination of method step and/or parts described and illustrated herein
30 is intended to represent only one embodiment of the present invention, and is not intended to serve as limitations of alternative method and/or devices within the spirit and scope of the invention.

CLAIMS

WHAT IS CLAIMED IS:

1. A method of milling an orthotic device by using a computer controlled milling tool, the orthotic device
5 defined by a orthotic device upper contour, the method comprising the steps of:

- a) providing a workpiece defining a mill plane and a perpendicular axis thereto;
- 10 b) milling the milling tool into the workpiece along the perpendicular axis to a depth corresponding to the orthotic device upper contour; and
- 15 c) translating the milling tool relative to the workpiece in the mill plane along a milling path while adjusting the depth of the milling tool to correspond to the orthotic device upper contour to selectively remove material from the workpiece for producing the orthotic device therefrom, the milling path being characterized by a plurality of mill rotations about the perpendicular axis,
20 successive ones of the mill rotations being radially further from the perpendicular axis.

2. The method of Claim 1 wherein step c) the milling tool is translated in the mill plane at a substantially
25 constant speed.

3. The method of Claim 1 wherein step c) the milling tool is sized and configured to perform a climb cut into the workpiece.
30

4. The method of Claim 1 wherein the milling tool has a spherical-shaped end mill and wherein step c) the

milling tool is translated along the milling path which aligns the spherical-shaped end mill tangentially with the orthotic device upper contour.

5 5. The method of Claim 1 wherein the mill rotations each include at least one elliptical section thereof.

10 6. The method of Claim 5 wherein the mill rotations are generally elliptical-shaped.

15 7. The method of Claim 1 wherein the orthotic device has opposing anterior and posterior portions thereof, given ones of a portion of the mill rotations each have an elliptical section adjacent the posterior portion.

20 8. The method of Claim 7 wherein the given ones of the portion of the mill rotations each have a first arced section and a second arced section disposed adjacent the anterior portion.

25 9. The method of Claim 1 wherein the orthotic device has opposing anterior and posterior portions thereof, the anterior portion has a primary width and the posterior portion has a secondary width, the primary width is greater than the secondary width.

30 10. The method of Claim 9 wherein given ones of a portion of the mill rotations each have an elliptical section disposed adjacent the posterior portion.

 11. The method of Claim 10 wherein the given ones of the portion of the mill rotations each have a first arced

section and a second arced section disposed adjacent the anterior portion.

12. A method of generating data for controlling a computer controlled milling tool to mill a workpiece to form an orthotic device therefrom having an orthotic device upper contour, the method comprising the steps of:

- a) accessing contour data representative of the orthotic device upper contour, the contour data being relatable to a mill plane and a perpendicular axis thereto; and
- b) generating milling path data using the accessed contour data, the milling path data being representative of a milling path characterized by a plurality of mill rotations about the perpendicular axis, successive ones of the mill rotations being radially further from the perpendicular axis.

13. The method of Claim 12 wherein the milling path data is calculated to translate the milling tool in the mill plane at a substantially constant speed.

14. The method of Claim 12 wherein the milling path data is calculated to configure the milling tool to perform a climb cut into the workpiece.

15. The method of Claim 12 wherein the milling tool has a spherical-shaped end mill and wherein step b) the milling path is calculated to align the spherical-shaped end mill tangentially with the orthotic device upper contour.

16. The method of Claim 12 wherein the mill rotations each include at least one elliptical section thereof.

17. The method of Claim 16 wherein the mill rotations
5 are generally elliptical-shaped.

18. The method of Claim 12 wherein the orthotic device has opposing anterior and posterior portions thereof, given ones of a portion of the mill rotations
10 each have an elliptical section adjacent the posterior portion.

19. The method of Claim 18 wherein the given ones of the portion of the mill rotations each have a first arced
15 section and a second arced section disposed adjacent the anterior portion.

20. The method of Claim 12 wherein the orthotic device has opposing anterior and posterior portions thereof, the anterior portion has a primary width and the
20 posterior portion has a secondary width, the primary width is greater than the secondary width.

21. The method of Claim 20 wherein given ones of a
25 portion of the mill rotations each have an elliptical section disposed adjacent the posterior portion.

22. The method of Claim 21 wherein the given ones of the portion of the mill rotations each have a first arced
30 section and a second arced section disposed adjacent the anterior portion.

23. A method of milling an orthotic device by using a computer controlled milling tool, the milling tool has a spherical-shaped end mill, the orthotic device defined by a orthotic device upper contour, the method comprising the steps of:

- a) providing a workpiece defining a mill plane and a perpendicular axis thereto;
- b) milling the milling tool into the workpiece along the perpendicular axis to a depth corresponding to the orthotic device upper contour; and
- c) translating the milling tool relative to the workpiece in the mill plane along a milling path while adjusting the depth of the milling tool to correspond to the orthotic device upper contour to selectively remove material from the workpiece for producing the orthotic device therefrom, the milling path being configured to align the spherical-shaped end mill tangentially with the orthotic device upper contour.

24. The method of Claim 23 wherein the milling path being characterized by a plurality of mill rotations about the perpendicular axis, successive ones of the mill rotations being radially further from the perpendicular axis.

25. The method of Claim 23 wherein step c) the milling tool is translated in the mill plane at a substantially constant speed.

26. A method of generating data for controlling a computer controlled milling tool to mill a workpiece to form an orthotic device therefrom having an orthotic device

upper contour, the milling tool has a spherical-shaped end mill, the method comprising the steps of:

- 5 a) accessing contour data representative of the orthotic device upper contour, the contour data being relatable to a mill plane and a perpendicular axis thereto; and
- 10 b) generating milling path data using the accessed contour data, the milling path data being representative of a milling path, the milling path being configured to align the spherical-shaped end mill tangentially with the orthotic device upper contour.

27. The method of Claim 26 wherein the milling path
15 being characterized by a plurality of mill rotations about the perpendicular axis, successive ones of the mill rotations being radially further from the perpendicular axis.

28. The method of Claim 26 wherein step b) the
20 milling tool is translated in the mill plane at a substantially constant speed.

ABSTRACT OF THE DISCLOSURE

In accordance with the present invention, there is provided a method of milling an orthotic device by using a computer controlled milling tool. The orthotic device is defined by a orthotic device upper contour. The method begins with providing a workpiece which defines a mill plane and a perpendicular axis thereto. The method further provides for milling the milling tool into the workpiece along the perpendicular axis to a depth corresponding to the orthotic device upper contour. The method further provides for translating the milling tool relative to the workpiece in the mill plane along a milling path while adjusting the depth of the milling tool to correspond to the orthotic device upper contour to selectively remove material from the workpiece for producing the orthotic device therefrom. The milling path is characterized by a plurality of mill rotations about the perpendicular axis. Successive ones of the mill rotations are radially further from the perpendicular axis.

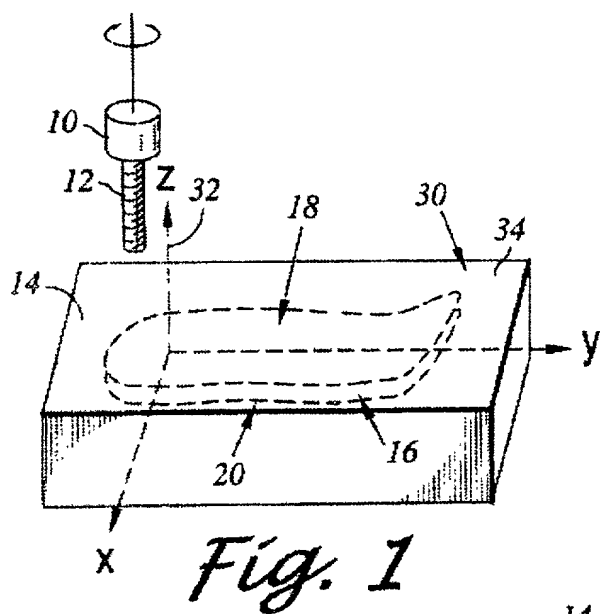


Fig. 1

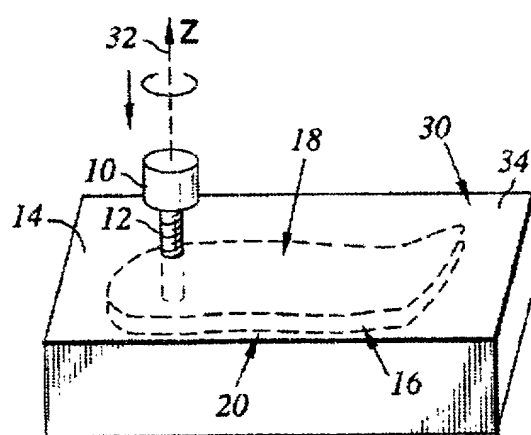


Fig. 2

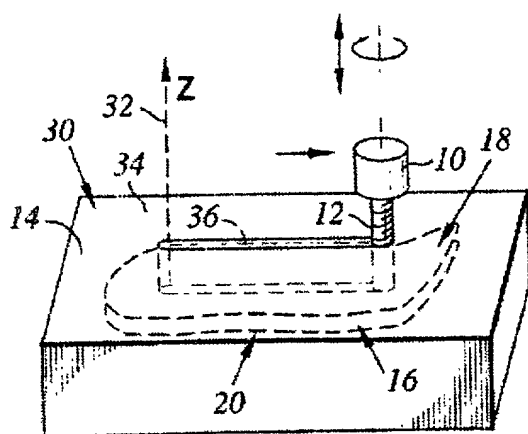


Fig. 3

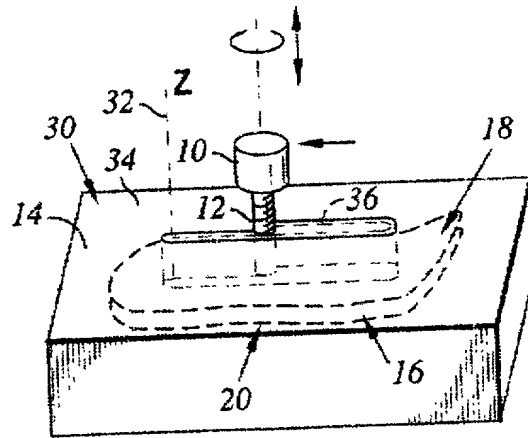


Fig. 4

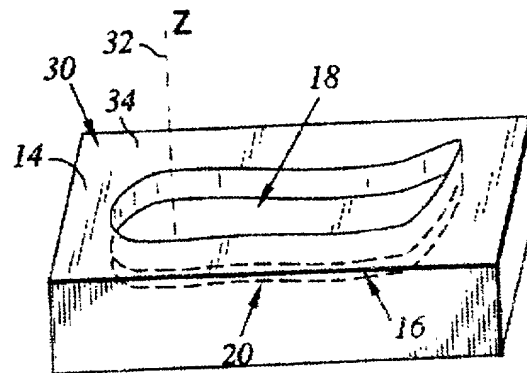


Fig. 5

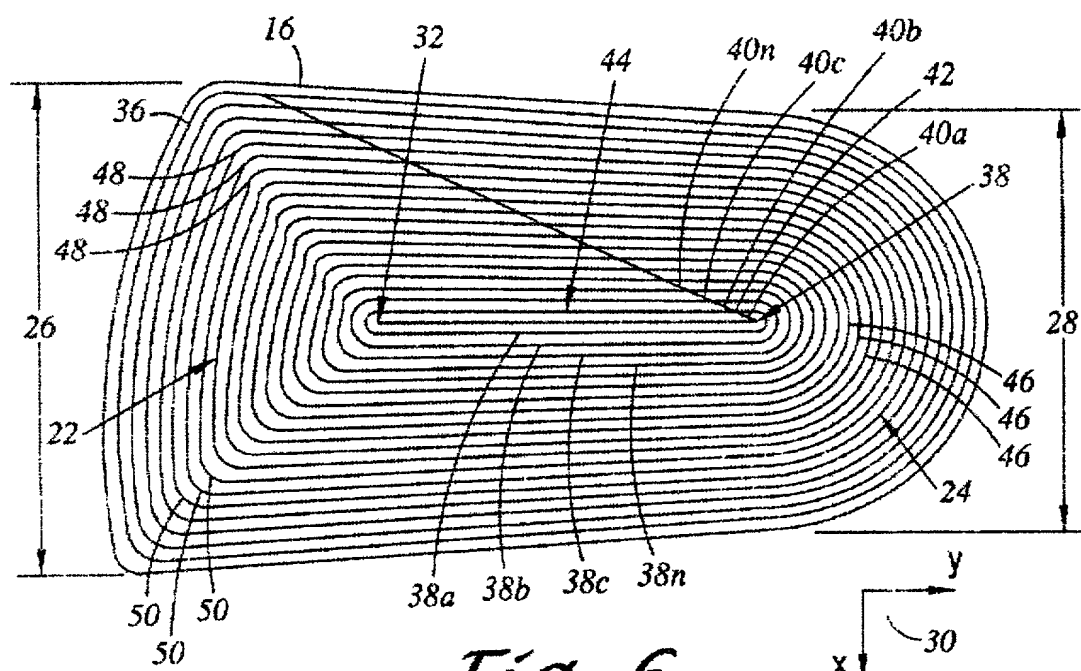


Fig. 6

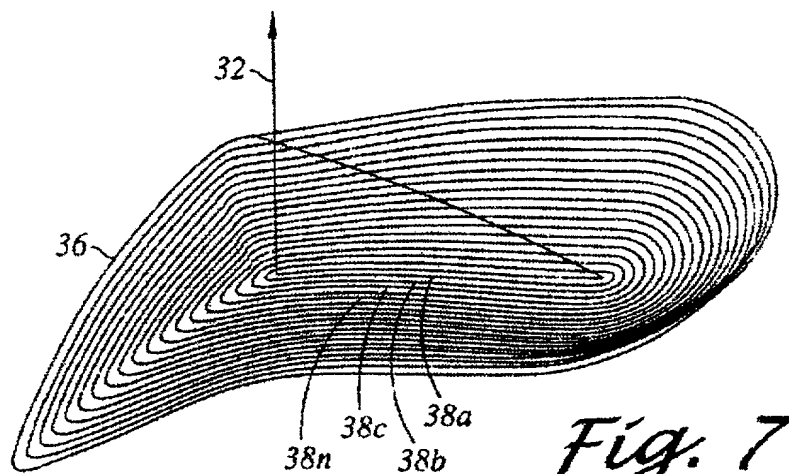


Fig. 7

Fig. 8

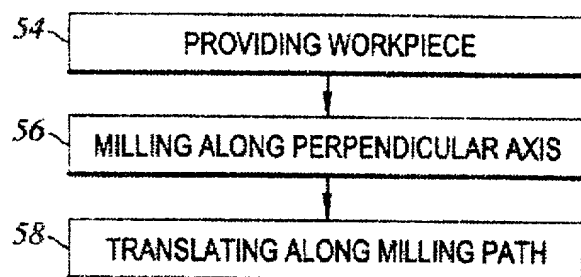


Fig. 9

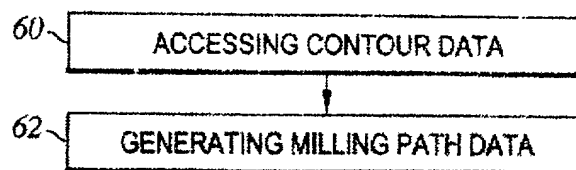


Fig. 10

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)	Attorney Docket Number		JARED-005A
	First Named Inventor		Stephen J. Jared
	COMPLETE IF KNOWN		
	Application Number		/
	Filing Date		Herewith
	Group Art Unit		Unknown
	Examiner Name		Unknown
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As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

**METHOD OF PRODUCING ORTHOTIC DEVICE UTILIZING MILL
PATH ABOUT PERPENDICULAR AXIS**

the specification of which (Title of the Invention)

☒ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) as United States Application Number or PCT International Application Number and was amended on (MM/DD/YYYY) (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims as amended by any amendment specifically referred to above

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached?	
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Application Number(s)	Filing Date (MM/DD/YYYY)

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[Page 1 of 2]

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U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

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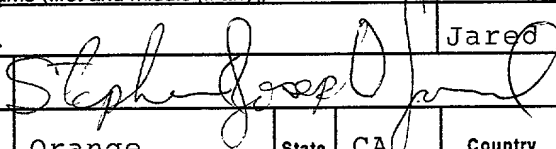
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Name of Sole or First Inventor:		<input type="checkbox"/> A petition has been filed for this unsigned inventor			
Given Name (first and middle (if any))		Family Name or Surname			
Stephen J.		Jared			
Inventor's Signature				Date	10/23/00
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Post Office Address					
City	Orange	State	CA	ZIP	92866
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